



Data Report: Testicular Cancer in Massachusetts, 1995-2005

Introduction:

Testicular Cancer in Massachusetts, 1995-2005 provides data on the incidence of and mortality from testicular cancer for the period 1995 through 2005 among residents of Massachusetts. This report presents Massachusetts overall testicular cancer incidence data by age and stage at diagnosis. Additionally, incidence data on specific subtypes of testicular cancers are presented along with survival data and information on secondary cancers among men previously diagnosed with testicular cancer. Unless noted otherwise, all data in this report are for the period 1995 through 2005. The purpose of this report is to raise awareness of testicular cancer since it is a cancer that can be detected early with routine self-screening.

Sources of Incidence and Mortality Data

Massachusetts Cancer Registry (MCR): Massachusetts incidence data are provided by the Massachusetts Cancer Registry, which is part of the Massachusetts Department of Public Health (MDPH). The MCR is a population-based cancer registry that began collecting reports of newly diagnosed cancer cases in 1982. Presently, the MCR collects reports from all Massachusetts acute care hospitals, one medical practice association, selected physician specialties (including hematologists/oncologists, dermatologists, and urologists), and two dermatopathology labs. The MCR also identifies cancers noted on death certificates that were not previously reported to the MCR and follows up on these death certificates for case finding. The North American Association of Central Cancer Registries (NAACCR) reviews cancer registry data for quality, completeness, and timeliness. For 2001-2005, NAACCR has estimated that MCR case ascertainment is over 95% complete for each year. The MCR has achieved the gold standard for this certification element as well as six other certification elements for each year since 1997. The Massachusetts cancer cases presented in this report are primary cases of invasive cancer—cancers that have moved beyond their area of origin to invade surrounding tissue—that were diagnosed among Massachusetts residents from 1995 to 2005.

Massachusetts Registry of Vital Records and Statistics: Massachusetts death data were obtained from the MDPH's Registry of Vital Records and Statistics, which has legal responsibility for collecting reports of deaths of Massachusetts residents.

Surveillance, Epidemiology and End Results (SEER) Program: National data on cancer incidence are from the National Cancer Institute's SEER Program, an authoritative source on cancer incidence in the United States that collects and publishes data from registries in selected areas. This report used data from the thirteen SEER registries (Atlanta, Connecticut, Detroit, Hawaii, Iowa, New Mexico, San Francisco-Oakland, Seattle-Puget Sound, Utah, Los Angeles, San Jose-Monterey, rural Georgia, and the Alaska Native Tumor Registry).

THE EPIDEMIOLOGY OF TESTICULAR CANCER

TESTICULAR CANCER

The American Cancer Society (ACS) summarizes the anatomy and physiology of the testes as follows: “The testicles are part of the male reproductive system. There are two testicles (testes), which are somewhat smaller than a golf ball in adult males. They are contained within a sac of skin called the scrotum, which is located beneath the penis. The testicles manufacture both the male hormones testosterone and sperm. Sperm cells are carried from the testicles through the vas deferens to the seminal vesicles, where they are mixed with fluid produced by the prostate gland. During ejaculation, sperm cells, seminal vesicle fluid, and prostatic fluid leave the body through the urethra, the tube in the center of the penis through which both urine and semen are passed.”¹

There are several types of cells in the testicles that may develop into one or more types of cancer. These will be discussed in a later section.

Risk Factors

There are a few risk factors that make a man more likely to develop testicular cancer. However, having one or more of these risk factors does not mean that someone will develop testicular cancer. In fact, most men with testicular cancer do not have any of the known risk factors.¹

Undescended testicle (cryptorchidism) – According to the ACS, “about 10% of cases of testicular cancer occur in men with a history of cryptorchidism, a condition that occurs when one of a newborn male’s testicles does not descend from the abdomen into the groin. This affects about 3% of newborn males. If the testicle has not descended by the age of one, a surgical procedure is sometimes performed to bring the testicle into the scrotum. Some experts believe that the risk of testicular cancer may be somewhat higher for men whose testicle stayed in the abdomen as opposed to one that had descended at least partway. Although most cancers develop in the undescended testicle, up to 25% occur in the normally descended testicle. Based on these observations, some doctors believe that cryptorchidism itself doesn’t actually cause testicular cancer, but rather that there is some other factor that may be associated with both testicular cancer and abnormal positioning of one or both testicles.”¹

Family history – The ACS states that “if a man has had testicular cancer, there’s an increased risk that one or more of his brothers or sons will also develop it. Only about 3% of testicular cancers, however, are familial.”¹

Cancer of the other testicle – The ACS reports that “about 3-4% of men who have been cured of cancer in one testicle will eventually develop cancer in the other testicle.”¹

Body size – A recent study from Sweden found an independent association between height and testicular cancer, with taller men having an increased risk. The study cited a

parallel between increasing incidence rates over the past 50 years and increasing height over the same time period. The study suggests a dietary and hormonal association with increasing height. There was, however, no association between testicular cancer and body mass index (BMI).²

Race/Ethnicity and Geography – The ACS reports that “the risk of testicular cancer among white, non-Hispanic men is about five times that of black men, non-Hispanics and more than three times that of Asian-American and Native American men. The risk for Hispanics falls between that of Asians and white, non-Hispanic men. The reasons for these differences are not known, but some studies exploring these differences are cited in the discussion section of this report. Worldwide, the risk of developing this disease is highest among men living in the United States and Europe and lowest among men living in Africa or Asia.”¹

HIV Infection – The ACS reports that “there has been some evidence to show that men infected with the human immunodeficiency virus (HIV), particularly those with AIDS, are at an increased risk of developing testicular cancer. No other infections have been shown to increase testicular cancer risk.”¹

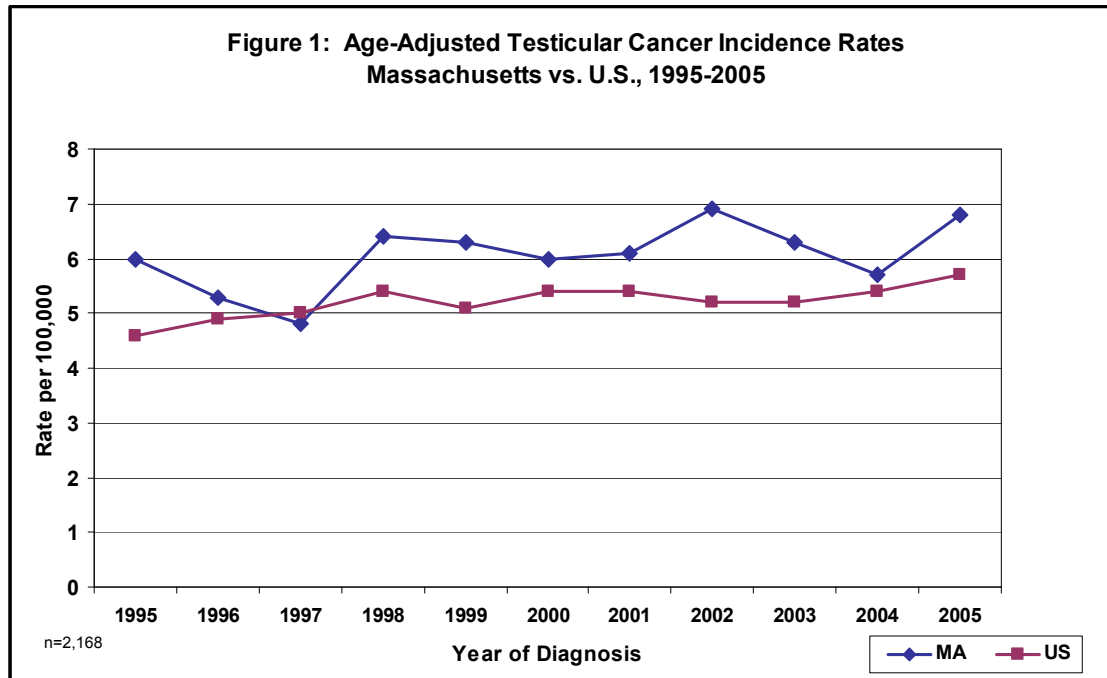
Genetics and Marijuana Use - Recent studies have found an association between marijuana use and testicular cancer and genetics and testicular cancer. These studies are presented in further detail at the end of this report.

Symptoms and Detection

According to the ACS, “in about 90% of testicular cancer cases, men have a lump on the testicle or they may notice the testicle is swollen or larger. Most of the time there is no pain associated with the tumor. Even when testicular cancer has spread to other organs, only about one man in four may have symptoms that suggest that the cancer has spread to the abdominal lymph nodes (lower back pain), or the lungs (shortness of breath, chest pain, or a cough). Abdominal pain can also occur due to enlarged lymph nodes or metastasis to the liver.¹ Confirmation is done by ultrasound, blood tests, or surgical biopsy.”

Incidence

In Massachusetts, there were 2,168 incident cases of testicular cancer diagnosed between 1995 and 2005. The overall incidence of testicular cancer increased non-significantly by 1.7% per year during this period (vs. 1.5% for the US as a whole (Figure 1)). Of these 2168 Massachusetts cases, 92.5% were in white, NH men, 1.1% were in black, non-Hispanic (NH) men, 1.2% were in Asian, NH men, and 2.7% were in Hispanic men. Race data were missing for 2.4% of the cases. Testicular cancer rates by race/ethnicity were not calculated due to the small numbers of cases in non-white men.



Data Sources: Massachusetts Cancer Registry and Surveillance, Epidemiology, and End Results Program

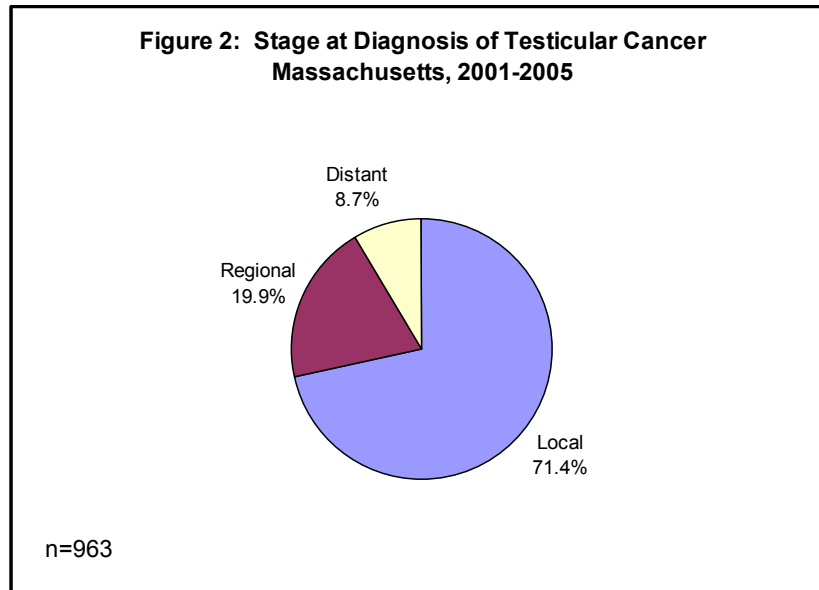
Mortality

In Massachusetts, there were 100 deaths due to testicular cancer from 1995-2005. The rate declined from 0.3/100,000 in 1995 to 0.1/100,000 in 2005. The number of deaths was too small to perform any meaningful trend analyses.

Stage at Diagnosis

Testicular cancer stages for this report were classified as local, regional, and distant. Stages are described in detail in the Technical Notes section of this report.

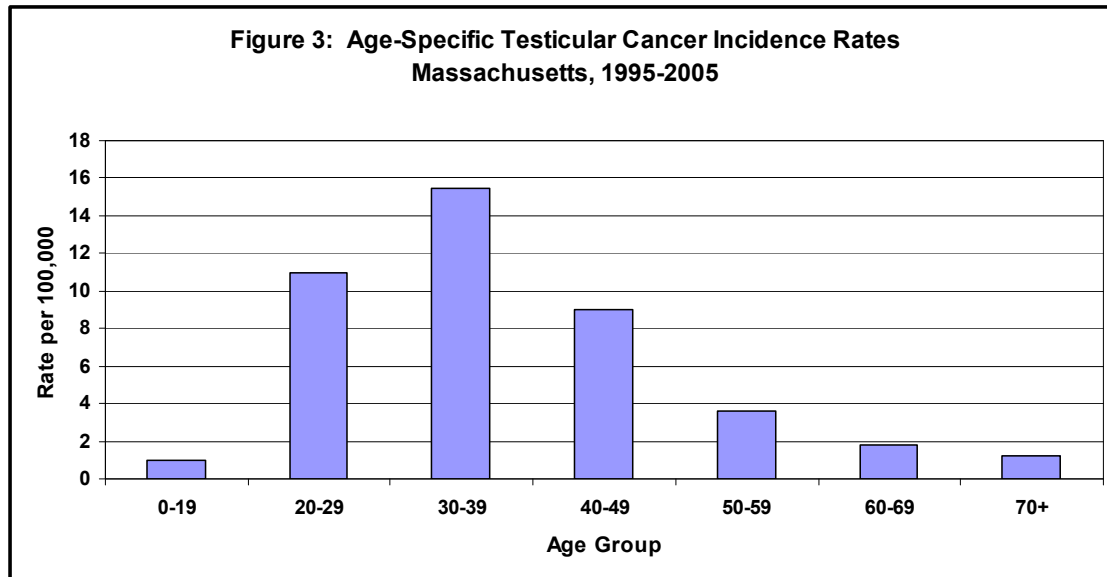
Since staging criteria were changed in 2000, stage at diagnosis was examined only for 2001-2005. The majority of cases were diagnosed at the local stage (71.4%), with 19.9% being diagnosed at the regional stage and 8.7% being diagnosed at the distant stage (Figure 2). Further staging data by age group are presented in the following section on age at diagnosis.



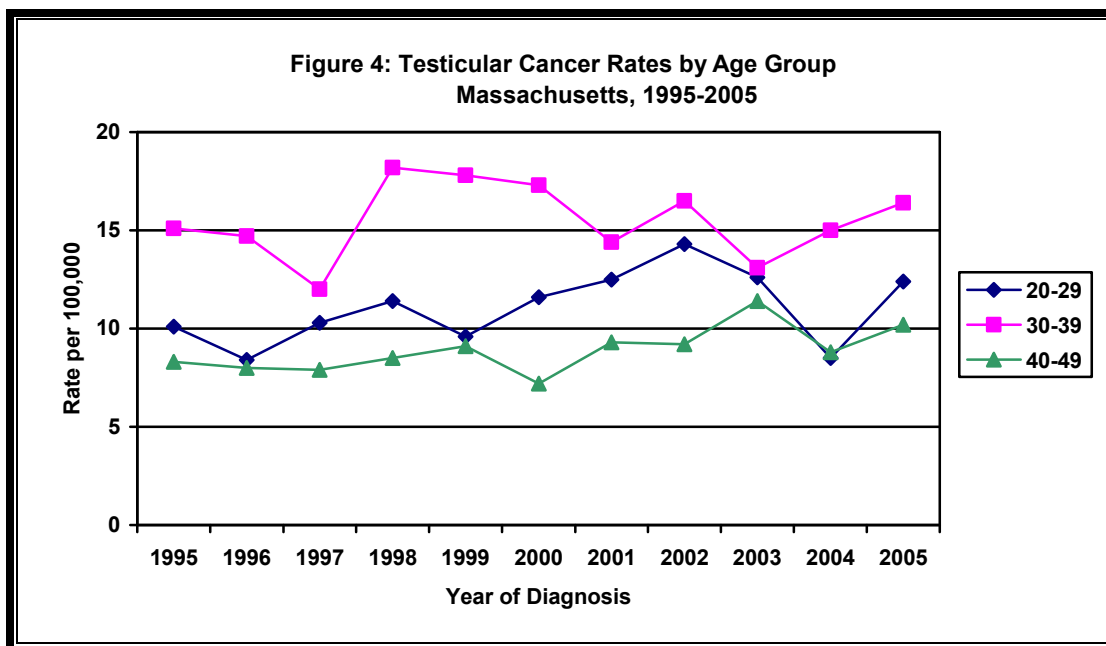
Data Source: Massachusetts Cancer Registry

Age at Diagnosis

The 10-year average annual incidence rates for testicular cancer in Massachusetts by age group are presented in Figure 3. The median age at diagnosis of testicular cancer was 35. From 2001 through 2005, it was the fifteenth most common cancer among males with an incidence rate of 6.3/100,000, compared to 170.6/100,000 for prostate cancer, the leading cancer rate. These rankings change dramatically when examining age-specific rates, however. From 1995 through 2005, testicular cancer was the leading cancer among men aged 20-29 and 30-39, with age specific rates of 11.0 and 15.5/100,000, respectively. It was the ninth most common cancer among men aged 40-49, with an age specific rate of 9.0/100,000. For men aged 50 and older, testicular cancer was rare, with an overall rate of 2.4/100,000. From 1995 to 2005—while the rates among men in their thirties were the highest, followed by men in their twenties and forties—there was no significant increase in the rates of men being diagnosed in their twenties or thirties. Among men in their forties, however, there was a significant increase in incidence of 2.5% per year (Figure 4).

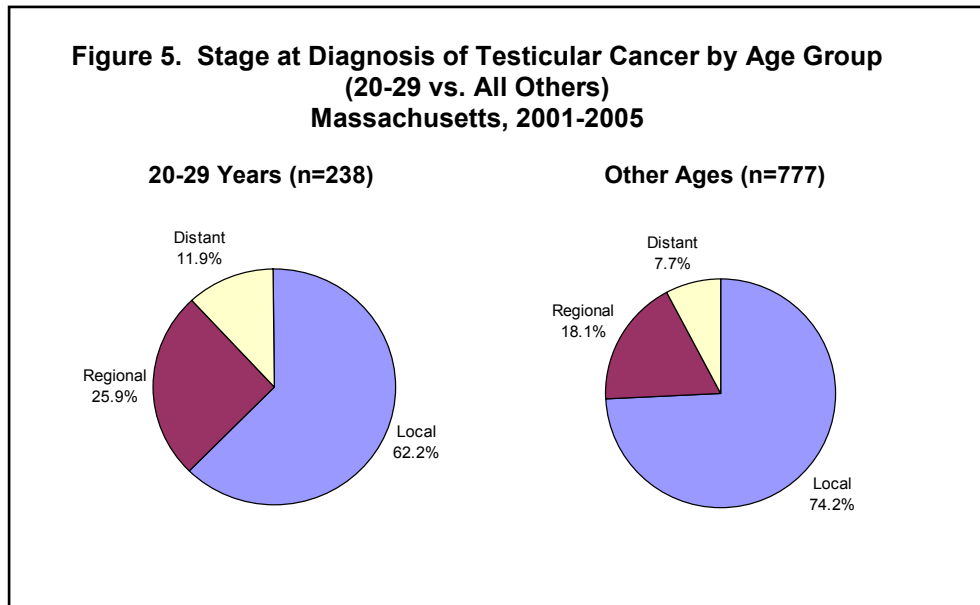


Data Source: Massachusetts Cancer Registry

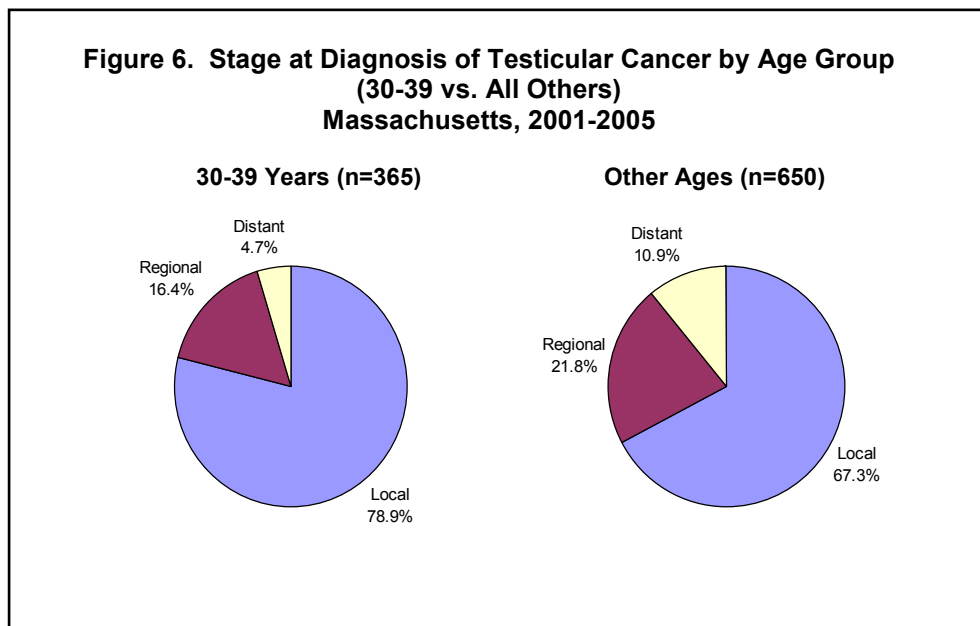


Data Source: Massachusetts Cancer Registry

Men in their twenties were significantly **less** likely to be diagnosed at the local stage compared to all other ages (Figure 5), while those in their thirties were significantly **more** likely to be diagnosed at that stage (Figure 6). There were no significant differences in stage at diagnosis when men in their forties were compared to all other age groups.



Data Source: Massachusetts Cancer Registry

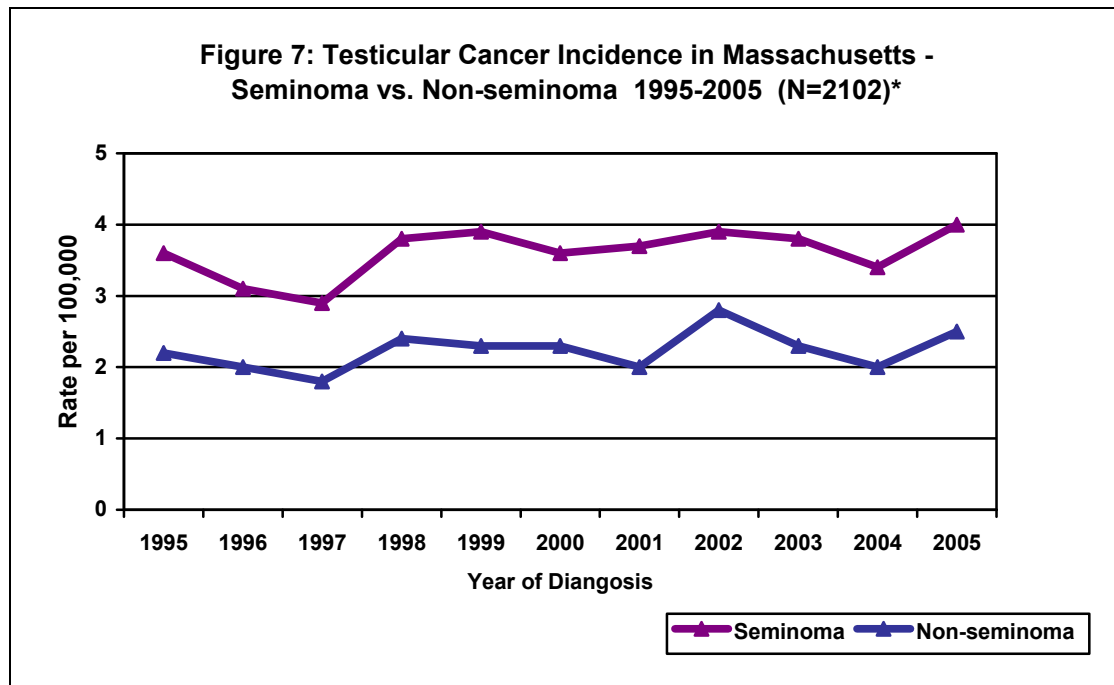


Data Source: Massachusetts Cancer Registry

Testicular Cancer by Subtype

There are two main types of testicular cancer: germ cell and non-germ cell. In Massachusetts, 97.6% of cases diagnosed from 1995-2005 were germ cell cancers. Breakdowns by cancer type and age groups are presented in Table 1 at the end of this section.

Germ Cell Tumors. The term “germ cell” refers to “giving of life.” Germ cells got their name because they normally reproduce the specialized cells that give rise to new life: sperm and egg cells. Germ cell tumors arise from these cells.³ This type of testicular cancer accounted for 97.6% of all testicular cancer cases. There are two types of germ cell tumors: seminomas and nonseminomas. From 1995 to 2005, there was a non-significant increase in the incidence of both types (Figure 7). This mirrored incidence rates for the US.



Seminomas develop from the sperm-producing germ cells of the testicle. The two main types are classical (typical) seminomas and spermatocytic seminomas. They are identified by their cellular makeup. There were 1,290 cases of seminoma diagnosed from 1995 to 2005, only 17 (1.3%) of which were spermatocytic. Seminomas represented 60.9% of all germ cell tumors and 59.5% of all testicular cancers. The median age at diagnosis for all seminomas from 1995-2005 was 37. Seminomas comprised 38.8% of all cases for 20-29 year olds compared to 67.1% of 30-39 year olds and 73.9% of 40-49 year olds. More than half of the 17 spermatocytic seminomas were diagnosed after the age of 60, however.

Nonseminomas consist of four main types: mixed germ cell carcinomas, embryonal carcinomas, teratomas, choriocarcinomas, and yolk sac carcinomas. There were 826

cases of nonseminomas diagnosed from 1995 to 2005. This represented 39.0% of all germ cell tumors and 38.5% of all testicular cancers. The median age at diagnosis for all nonseminomas was 30. Small numbers for the subtypes of nonseminomas precluded any trend or stage at diagnosis analyses.

Mixed Germ Cell Carcinomas contain a mixture of seminomas and nonseminomas. (If a tumor contains any portion of nonseminomatous tissue, it is classified as a nonseminoma. If the tumor contains only seminoma cells, it is called a pure seminoma.⁴) There were 474 mixed germ cell carcinomas diagnosed from 1995 to 2005, or 21.8 % of all testicular cancers and 57.4% of all nonseminomas. The median age at diagnosis for mixed germ cell carcinomas was 31.

Embryonal carcinomas resemble the tissues of very early embryos. This type of nonseminoma tends to grow rapidly and spread outside the testicle.¹ There were 192 cases of embryonal carcinomas reported from 1995 to 2005. Embryonal carcinomas represented 8.9% of all testicular cancers and 23.2% of all nonseminomas. The median age at diagnosis for embryonal carcinomas was 29.

Teratomas are germ cell tumors with areas that resemble the three layers of a developing embryo under the microscope: the endoderm (innermost layer), mesoderm (middle layer), and ectoderm (outer layer).¹ There were 95 cases of teratoma diagnosed from 1995 to 2005, or 4.4% of all testicular cancers and 11.5% of nonseminomas. The median age at diagnosis for teratomas was 27.

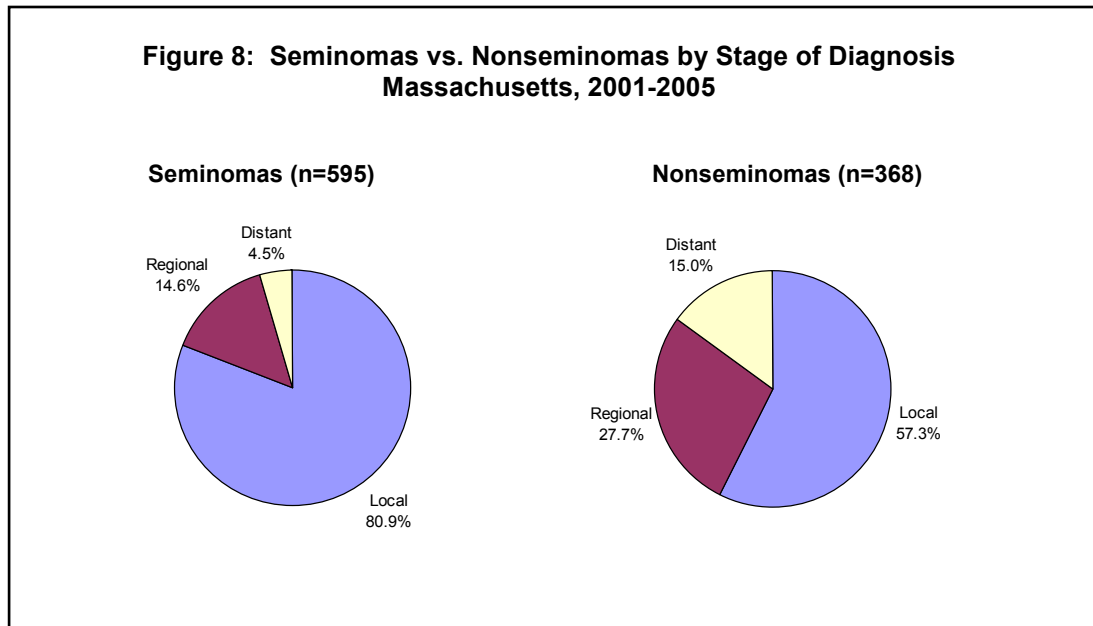
Choriocarcinoma is a very rare and aggressive type of testicular cancer. This cancer is more likely to spread rapidly to distant parts of the body, including the lungs, bone, and brain.¹ There were 26 cases of choriocarcinoma diagnosed from 1995 to 2005, or 1.2% of all testicular cancers and 3.1% of all nonseminomas. The median age at diagnosis for choriocarcinomas was 28.

Yolk sac carcinomas resemble the yolk sac of an early human embryo. It is the most common form of testicular cancer in children. In children, yolk sac tumors are usually treated successfully, but are of more concern in adults.¹ There were 25 cases of yolk sac carcinoma diagnosed from 1995 to 2005, with nearly half (44.0%) of those cases diagnosed before the age of 20. These tumors represented 1.1% of all testicular cancers and 3.0% of nonseminomas. The median age at diagnosis for yolk sac carcinomas was 24.

Non-Germ Cell Tumors. These tumors of the testicle arise from cells which are not germ cells. The 52 cases represented only two percent of all testicular cancers. The main type of non-germ cell tumor is the Leydig cell tumor. This tumor develops in the Leydig cells in the testicle, which normally produce male sex hormones (androgens and testosterone).¹ There were 14 cases of Leydig cell tumors diagnosed from 1995 to 2005, or less than 1% of all testicular cancers and 26.9% of all non-germ cell cancers. The median age at diagnosis for Leydig cell tumors was 42.

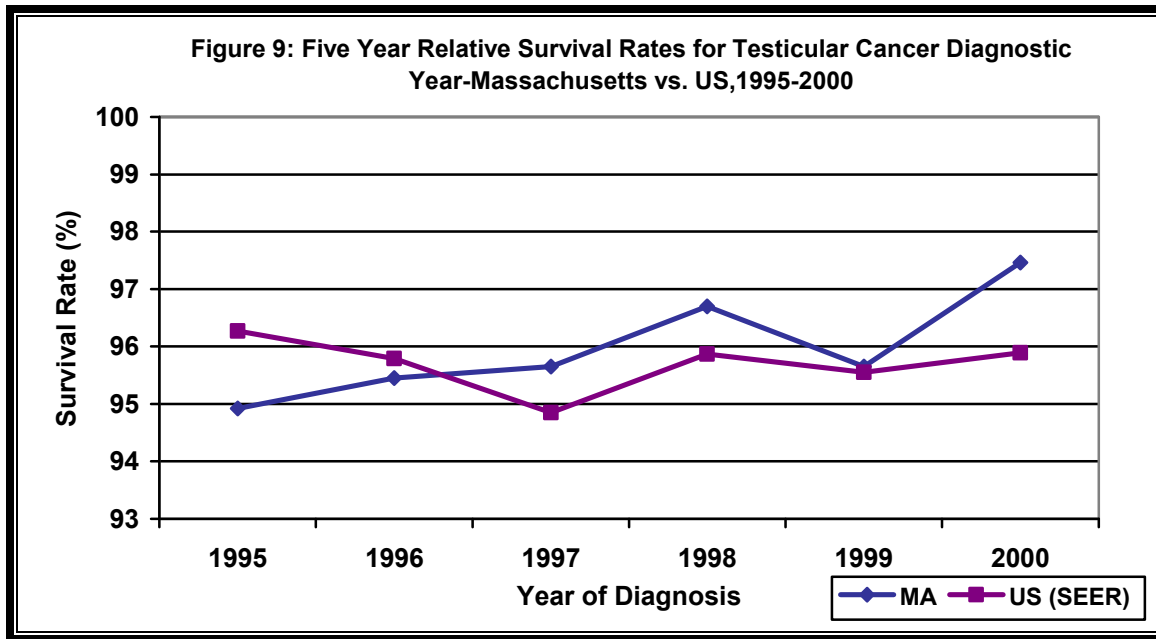
TABLE 1: Testicular Cancer by Histological Subtype 1995-2005								
		Age Group						
Histology	Cases	<20	20-29	30-39	40-49	50-59	60-69	70+
Total	2,168	91	541	854	472	134	42	34
Germ Cell	2,116	82	530	839	463	129	37	22
Seminomas	1,290	5	208	573	349	102	34	19
Classical	1,273	5	206	571	346	101	30	14
Spermatocytic	17	0	<5	<5	<5	<5	<5	5
Nonseminomas	826	77	327	273	115	27	<5	<5
Embryonal	192	15	84	59	24	7	<5	<5
Yolk Sac	25	11	6	<5	<5	0	<5	0
Teratoma	95	11	50	20	8	4	0	<5
Mixed Germ Cell	474	40	168	174	77	14	<5	0
Choriocarcinoma	26	0	14	9	<5	<5	0	0
NOS*	14	0	5	7	<1	0	<1	0
Non-Germ Cell	52	9	6	8	8	5	<5	12
Leydig Cell Tumor	14	0	<5	<5	<5	<5	0	<5
Other Non-Germ	38	9	<5	<5	<5	<5	<5	10
* The specific type of nonseminoma was not specified. Data Source: Massachusetts Cancer Registry								

During the period of 2001 to 2005, seminomas were significantly more likely to be diagnosed at the local stage compared to nonseminomas (80.9% vs. 57.3%) (Figure 8).



Survival

Since mortality data was available through 2005, 5-year survival rates could be calculated for men diagnosed with testicular cancer between 1995 and 2000 (n=1,150). It should be noted that there were 70 deaths among these men from 1995 through 2005. For the purposes of determining cause specific survival rates, however, only cancer as an underlying cause of death was used (n=46). Utilizing Kaplan-Meier analysis, nearly 95% of men diagnosed in 1995 were alive after 5 years. Over the next 5 diagnostic years (1996 through 2000), the percentage of men still alive after 5 years ranged from 95.5% to 97.5%, with an overall percentage of 96%. These rates were comparable to national rates (Figure 9).



Data Sources: Massachusetts Cancer Registry and Surveillance, Epidemiology, and End Results Program

Of those men diagnosed with seminomas from 1995 to 2000, 97.5% survived greater than 5 years. This was a slightly better survival rate than those diagnosed with nonseminomas (94.5%) and much better than those diagnosed with a non-germ cell testicular cancer (78.3%). Of those diagnosed with any type of testicular cancer at the local stage, 99.1% survived greater than 5 years compared to 97.5% of those diagnosed at the regional stage and 66.0% of those diagnosed at the distant stage. Only 3.8% of cases had an unknown stage at diagnosis and were excluded from the analysis.

Cancer of the Contralateral Testis:

A contralateral testicular cancer was a cancer in the other testis that was diagnosed among men who had originally been diagnosed with testicular cancer between 1995 and 2000. (These years were chosen so that there was at least 5 years of follow-up time available following the initial diagnosis of testicular cancer.) The contralateral cancer needed to be diagnosed more than 6 months after the original testicular cancer diagnosis, to account for simultaneous or near-simultaneous diagnoses of testicular cancer in both testes. The expected number of contralateral cancer cases was calculated by multiplying the rate of testicular cancer among the 20-49 general male population by the total number of testicular cancer cases (n=1101). The analysis was limited to 20 to 49-year-old men because this is the age range within which most men (85.5%) are diagnosed with testicular cancer.

From 1995-2000 there were 1,101 cases of testicular cancer among men aged 20-49. Of these 1,101 cases with 5 years of follow-up, 14 (1.4%) went on to develop a contralateral testicular cancer. The expected number of testicular cancer cases for 1101 men without a

history of testicular cancer aged 20-49 in the general Massachusetts population based on the statewide rate of testicular cancer in the 20-49 male population for 2001 to 2005 was less than one. Among males aged 20 to 49 who had testicular cancer from 1995 to 2000, their risk of developing a cancer in the contralateral testicle 6 months or more post-diagnosis was over 100 times that of the general male population.

DISCUSSION AND SUMMARY

The overall incidence rate of testicular cancer increased non-significantly from 1995 to 2005. This reflected national trends over the same time period. Fortunately, testicular cancer has one of the lowest mortality rates of all cancers. From 1995-2005, there were 100 deaths and the mortality rate remained well below 1/100,000. The prognosis for testicular cancer has greatly improved since the introduction of cisplatin-based chemotherapy during the late 1970s. Still, the fact that men do still die from this disease points to the need for even better early detection and prompt treatment after diagnosis.⁵

From 1995 through 2005, there were 2,006 cases of testicular cancer diagnosed among white, NHs (92.5% of the total of 2,168 cases) compared with only 24 among black, NHs (1.1% of the total), 59 among Hispanics (2.7%) and 26 cases among Asian, NHs (1.2%). There were 52 cases with an unknown race/ethnicity and fewer than 5 cases among Native Americans. Asian, NHs and Hispanics represented 1.2% and 2.7%, respectively, of testicular cancers and a comparable percentage of all cancers (1.3% and 2.0%, respectively). Black NHs, however, represented only 1.1% of all testicular cancers vs. 3.4% of all invasive cancers, a distinct difference. There are many proposed explanations for this well-documented disparity, including gestational hormonal differences, genetic susceptibility, environmental pollution susceptibility, environmental pollution exposure, and occupational exposure.⁶ Gestational hormonal differences have shown maternal serum testosterone and androstenedione levels to be significantly higher among blacks compared to whites. While this suggests that hormones may contribute to the disparity in testicular neoplasms between blacks and whites, the roles of genetics, lifestyle, and environment need to be examined in further detail.⁶ A study from 1993 examining testicular cancer among blacks found that testicular tumors behave similarly to those in whites.⁷

With a median age of 35 at diagnosis, testicular cancer is a disease of younger males compared with most other cancers, and was the leading cancer among men aged 20-29 and 30-39 for 1995-2005. Interestingly, however, men in their twenties were significantly *less* likely to be diagnosed at the local stage compared to all other ages, while men in their thirties were significantly *more* likely to be diagnosed at that stage. Recent studies have shown knowledge of both testicular cancer and of how to perform a testicular self-examination (TSE) to be low to moderate in younger age groups.⁸ A recent study of 203 male undergraduate and graduate university students in the United Kingdom found that only 32.0% had prior knowledge of TSE, that 22.0% practiced TSE regularly, and that only one was able to recognize the correct procedure.⁹ Another study in Australia with the same age group found that only 17.8% performed TSE once a month as recommended and 55.0% never performed TSE.¹⁰ Some of the barriers to performing

TSE include men's perceptions that they are not prone to testicular cancer, the belief that TSE is not important to health, perceived unpleasantness of TSE, the expectation that it is time consuming, fears about its reliability, and fears about what the procedure may reveal.⁸ The finding that men in their 30s were more likely to be diagnosed at an earlier stage may reflect a change in attitudes. By the time a man is in his thirties, he is settled into a job and has better access to health care. Also, his feelings of being invincible to disease diminish and he is more likely to pay attention to symptoms.⁸ The finding that incidence rates in men in their 40s have been significantly increasing, as compared with the two younger age groups, may point to the need for testicular screening to continue beyond the age of 40.

Cases of seminoma were significantly more likely to be diagnosed at an earlier stage of cancer than cases of nonseminomas. This finding is similar to an earlier study of Massachusetts data from 1995 to 2002.¹¹ Another study from Iceland had similar findings, with seminomas significantly more likely to be diagnosed at the local stage compared with nonseminomas.¹²

The finding of an elevated risk of a contralateral testicular tumor diagnosed a year or more after an initial testicular cancer diagnosis has been documented by other studies in the United States and Canada. These studies found anywhere from a 12- to 38-fold higher risk of developing a new testicular cancer compared with men from the general population.¹³ Our results showed a 100-fold higher risk of developing cancer in the contralateral testis 6 or more months after diagnosis of the first testicular cancer. All of these results point to the need for regular TSEs of the remaining testis among men previously diagnosed with testicular cancer.

A recently published case-control study examined men in the state of Washington who were diagnosed with testicular germ cell cancer (TGCC) from 1999 to 2006 and compared their marijuana use with that of controls who did not have TGCC. The study found that men with TGCC were more likely to be current marijuana smokers at diagnosis compared with controls. Most of the association between current marijuana use and TGCC was observed in men who had nonseminomas or mixed histology tumors. Being less than 18 at first use of marijuana among current users, and daily or weekly marijuana use appeared to increase the risk. The researchers have hypothesized that marijuana may disrupt a cannabinoid-like chemical produced naturally by the male reproductive system that is thought to have a protective effect against cancer, thus increasing the risk of testicular cancer in marijuana users. The researchers stressed, however, that there were many unanswered questions and that more research on cannabinoid receptors in both seminomatous and nonseminomatous tumors need to be studied.¹⁴

The first inherited genetic risk factors for testicular cancer were recently described in an article from the Institute of Cancer Research in the United Kingdom. When comparing the genes of 730 men with testicular cancer with those of men without, they found that many of the men with cancer shared common DNA variants on chromosomes 5, 6, and 12, which the men without cancer did not. Men who inherited any of the genetic variants

were at a higher risk of developing the disease than those who do not. Inheriting the strongest of the three factors increased men's risk by two- to threefold, while inheriting all of them increased the risk by up to fourfold.^{15,16}

Summary Points

- The incidence rate of testicular cancer has been increasing non-significantly in Massachusetts from 1995 to 2005. This is true of both subtypes, seminoma and nonseminoma. These trends reflect those in the United States for the same time period.
- Mortality from testicular cancer from 1995 to 2005 was very low with an average annual death rate of less than 0.5/100,000.
- Testicular cancer primarily affects white, non-Hispanic males. This group accounted for 92.5% of testicular cancer cases diagnosed from 1995 to 2005.
- The median age at diagnosis for testicular cancer was 35. It was the top-ranked cancer for men in their twenties and thirties. Men in their twenties were significantly *less* likely to be diagnosed at the local stage than men in other age groups, while men in their thirties were significantly *more* likely to be diagnosed at the local stage.
- Men diagnosed with cancer in one testicle between ages 20 and 49 were at a greater than 100-fold risk of developing one in the other testicle a year or more after diagnosis of the first cancer.
- Seminomas were significantly more likely to be diagnosed at the local stage compared to nonseminomas from 2001-2005, 80.9% vs. 57.3% respectively.
- From 1995 to 2005, seminomas were diagnosed at a higher median age (37) compared to non-seminomas (30). Seminomas comprised 38.4% of all cases for 20-29 year olds compared to 67.0% of 30-39 year olds and 73.9% of 40-49 year olds.
- For cases diagnosed from 1995 to 2000, the percentage of men still alive after 5 years ranged from 95.0% to 97.5%, with an overall percentage of 96.0%. These rates were comparable to national rates
- Of those men diagnosed with seminomas from 1995 to 2000, 97.5% survived greater than 5 years. This was a slightly better survival rate than those diagnosed with nonseminomas (94.5%) and much better than those diagnosed with a non-germ cell testicular cancer (78.3%). Of those diagnosed with any type of testicular cancer at the local stage, 99.1% survived greater than 5 years compared to 97.5% of those diagnosed at the regional stage and 66.0% of those diagnosed at the distant stage.

TECHNICAL NOTES AND DEFINITIONS

Statistical Terms

Incidence – The number of people who are newly diagnosed with a disease, condition, or illness during a particular time period. The incidence data presented here were coded using the International Classification of Disease for Oncology (ICD-O) coding system.

Mortality – The number of people who die from a disease, condition, or illness during a particular time period. The mortality data presented here were obtained from the Massachusetts Registry of Vital Records and Statistics and are based on International Classification of Disease, Version 10 (ICD-10) codes.

Age-specific rate – This is a rate among people of a particular age range in a given time period. Age-specific rates were calculated by dividing the number of people in an age group who were newly diagnosed with cancer (incidence) or died of cancer (mortality) by the number of people in that same age group overall.

Age-adjusted rate – This is a rate that takes into account the age structure of a population, allowing for the comparison of populations with different age distributions. Age-adjusted rates were calculated by weighting the age-specific rates for a given year by the age distribution of the 2000 U.S. standard population. The weighted age-specific rates were then added to produce the adjusted rate for all ages combined. Rates should only be compared if they have been adjusted to the same standard population.

Median age at diagnosis – The median age at cancer diagnosis is the age at which half of the ages at diagnosis are older and half are younger. This is an indicator of the demographic pattern of a cancer as compared to that of the underlying population

Population estimates – The population estimates for this report were produced by the National Center for Health Statistics (NCHS) in collaboration with the Census Bureau's Population Estimation Program. Each year, in addition to releasing the most recent year's population estimates, the Census Bureau also revises the previous year's estimates, including the Census 2000 estimates. The NCHS takes the Census Bureau population estimates file and reallocates the multiple race categories required by the 1997 Office of Management and Budget (OMB) back into the four race categories specified in the 1977 OMB specifications so that the estimates will be compatible with previous years' populations.

Confidence intervals (CIs) [also called Confidence limits (CLs)] – This is a range of values determined by the degree of variability of the data, within which the true value should lie. The 95% confidence intervals presented in this report mean that 95 times out of 100 this range of values will contain the true one. The confidence interval indicates the precision of the rate calculation; the wider the interval, the less certain the rate. Statistically, the width of the interval reflects the size of the population and the number of events; smaller populations and smaller numbers of cases yield less precise estimates that have wider confidence intervals. In this report, confidence intervals were used as a conservative statistical test to estimate the difference between the age-adjusted incidence or mortality rates with the probability of error of 5% or less ($p \leq 0.05$, or p-value less than 0.05).

Statistical significance – An estimate of the probability that the difference between groups is due to chance alone. In this report, differences in cancer stage and tumor size at diagnosis between groups were considered statistically significant when the p-value was less than or equal to 0.05.

The **Kaplan–Meier estimator**- Also known as the product limit estimator, it estimates the survival function from life-time data. In cancer research, it can be used to measure the fraction of cases living for a certain amount of time after diagnosis i.e. five years.

Trend – Trend data were analyzed using the Joinpoint Regression Program from the National Cancer Institute. This program identifies joined line segments that are connected by points where the trend changes. An annual percent change (APC) describes the average change per year over the line segment. A positive APC corresponds to an increasing trend, and a negative APC corresponds to a decreasing trend. Joinpoint analysis determines whether or not the APC is significant.

Invasive cancer – A cancer that has spread beyond the layer of tissue in which it developed and is growing into surrounding healthy tissues.

Stages of cancer -

- ***In situ* (early stage)** – This is the earliest stage of cancer, before the cancer has spread, when it is limited to a number of small cells and has not invaded the organ itself.
- **Localized (early stage)** – Cancer is found only in the body part (organ) where it began; it has not spread to any other parts.
- **Regional (late stage)** – The cancer has spread beyond the original point where it started to the surrounding parts of the body (other tissues).
- **Distant (late stage)** – The cancer has spread to parts of the body far away from the original point where it began. This is the most difficult stage to treat, since the cancer has spread through the body.
- **Unstaged** – There is not enough information about the cancer to assign a stage.

Site Codes and Histologies: The site codes for testicular cancer are C620-C629, based on the *International Classification of Diseases for Oncology, Third Edition* (ICD-O-3).¹⁷ The following subtypes of testicular cancer were based on the following histology codes from the ICD-O-3 manual:

Seminoma – 9060 to 9064

 Spermatocytic seminoma – 9063

Nonseminoma – 9065-9101

 Embryonal – 9070, 9072

 Yolk sac – 9071

 Teratoma – 9080-9084

 Mixed germ cell – 9085

 Choriocarcinoma – 9100-9101

Non Germ Cell – all other histologies (except lymphomas)

 Leydig cell tumor - 8650

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